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A Clear Explanation of This Simple Method of Obtaining Permanent Prints in Color; with Modern Modifications; and a Detailed Account of all the Applications of the Process: Failures and Remedies : Notes and News . Books and Prints

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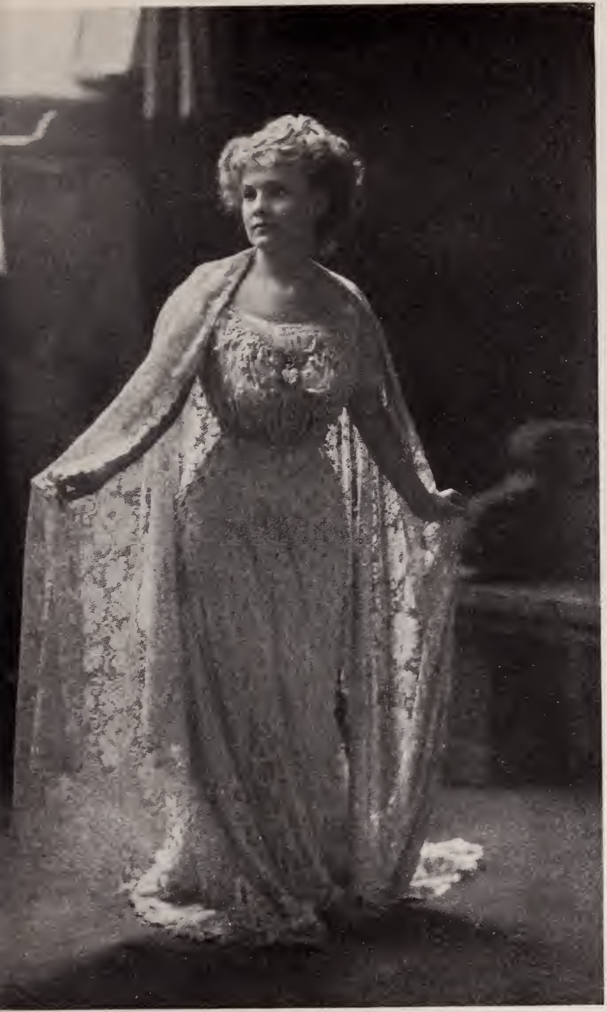

A Pose by Hill, New York

The Clock-mender
(Author unknown)

The Photo-Miniature
A Magazine of Photographic Information
EDITED BY JOHN A. TENNANT
AND THOMAS BEDDING, F. R. P. S.
Volume VIII FEBRUARY, 1908 Number 86

Carbon Printing

The developing agent used in the process of carbon printing is plain water; and the final image of the picture consists of a deposit of pigmentary matter in a film of gelatine. These two properties give to the process the character of simplicity and permanency which it acquired upon its original introduction: a character of which the competition of many other printing processes has not deprived it. Besides its simplicity and permanency, the process has other claims to notice. The print may be in almost any color desired—from an engraving black to a warm red. The process may be employed for the production of direct contact prints, and for enlargements on paper, fabric, glass, opal and many other supports. Transparencies and lantern slides are made in carbon; and the modern demand for pictures in natural colors is flattered by the application of the principles of trichromatics to the process. It is not only the technician that is catered for in carbon printing: the ever-growing army of pictorialists find their requirements satisfied in this most beautiful and adaptable method of making pictures by photography. So we have the process modified to give images on rough-surface papers, on Japanese tissue, and on other surfaces complying with the latest formularies of esthetic taste. It all comes to this: that in carbon we have at hand a process of forty years' standing which has answered the test of time and experience, and, besides satisfying every reasonable demand of the technician and the pictorialist for responsiveness of effect aimed at, has, nevertheless, a wonderful facility for yielding to the fluctuations of taste and change. The latest manifestations of this charming plasticity supply the basis of this monograph.

Outlines of the Process

As we have already pointed out, the carbon process is a printing method which by exposure and development gives a print in which the picture consists of permanent pigment, such as carbon, embedded in a thin film or tissue of insoluble gelatine. In its first state carbon paper is a film or tissue of gelatine with which is incorporated pigment or coloring matter, coated on a sheet of paper intended merely to support the film during exposure. By immersion in a solution of potassium bichromate the tissue is "sensitized," i e., acquires the property of becoming insoluble upon exposure to light. When exposed to light under a negative, in the usual way, the tissue is rendered insoluble in proportion to the amount of light which has acted upon it at different parts of the negative image. In development the exposed tissue is washed with water. This causes the soluble portions of the pigmented film (i. e., those portions more or less protected from light by the density of the negative) to dissolve and clear away. By this we get a positive image in pigmented gelatine. The color of the image varies according to the pigment incorporated with the gelatine forming the tissue. The permanency of the print depends upon the permanency of the pigment employed in making the tissue. The exposed film or tissue being transferred (by a simple operation) before development to a second (temporary or final) support, permits of any desired modification in the surface finish or texture of the print, and the choice of a variety of supports, such as different kinds of paper, opal, glass, wood, leather, metals, or other surfaces.

Tissues and Materials

The variety of material and tissues on the market for carbon printing is very great. The Autotype Company supply tissues charged with colored pigments of thirty different colors in rolls and cut sheets for direct printing on paper, for photogravure and transparencies. The tissues of Elliott & Son are also available in fifteen different colors, and in more recent years Wellington & Ward, and Illingworth & Co., all English houses, have placed tissue and material on the market. It may be noted, that these firms supply trial outfits for carbon printing, a convenience which the small worker should appreciate.

Transfer Papers and Supports

Transfer papers, single or double, are obtainable from dealers in carbon supplies; and some form of temporary support will be required. This is used to support the exposed film in development where the double transfer method is used. The temporary support may be a piece of glass, or opal, or a prepared paper called flexible support—that is, paper coated with insoluble gelatine and shellac, so that it is impervious to water. The surface texture of the temporary support determines the surface finish of the print. Thus, to get matt-surface prints, ground opal or grained zinc is employed as the support; for an ordinary glazed surfaced finish the flexible support, waxed, is used. Celluloid is useful for this purpose. In any event the temporary support must be a little larger all around than the piece of tissue in use.

Apparatus

A thermometer; a scraper squeegee; a few ounces of bichromate of potassium; three pieces of rubberized cloth or waterproof fabric, a little larger in size than the prints proposed to be made; a supply of waxing preparation: a bottle of plain collodion; trays for sensitizing and printing-frames; are the principal requirements for the process, it being assumed that the worker is in possession of most of them in his ordinary practice. The cut tissue should be stored away under pressure except when intended for immediate use. Unless so stored, it has a tendency to curl up around the edges and is unmanageable in the printing-frame. It should not be stored where it will become damp or moldy.

The Process in Practice

The operations for making a carbon print are briefly as follows: The tissue is first cut to the exact size of the negatives from which prints are to be made; it is then sensitized and, after drying, stored away until required for use. In use it is exposed under a negative, immersed in water with a temporary support (or a piece of final support), squeegeed into absolute contact with this new support and placed under pressure. This transfer of the film to the new support being effected, the tissue, with a support on both sides of the film, is immersed in warm water. In this the original support of the film loosens and is removed, and the picture is developed by laving the film with water. Development completed, the print, now on the temporary support (or final support if it is to be a single transfer print), is cleared in an alum bath, and dried. If the print was transferred to a temporary support, it is again transferred after development to the final support—which may be paper, wood, metal, glass, leather, etc.—and after drying is stripped from the temporary support, which completes it.

If the tissue is bought in cut sizes, of course there is no cutting to size to do. If bought in rolls, a piece of zinc not less than the width of the roll will be found most useful, as the stiff, gelatinized paper curls in a pesky fashion when handled. Two edges of the sheet of zinc should be accurately squared and preferably marked off in inches on these two edges. With this a T-square of proper size is used and the cutting done with a sharp knife, a shoemaker's knife being good for the purpose. With these articles, and weights of some kind to keep the tissue from rolling up, no trouble will be found in cutting it accurately to any desired sizes.

The Sensitizing Solution

The first question in sensitizing is, as to the strength and constituents of the solution. This depends upon a number of factors: first, the season; second, climatic conditions; third, character of negatives ordinarily used, and fourth, the character of results desired. In spring and summer, or in damp, moist climates such as we have in our southern coast states, the tissue has a tendency to become insoluble in drying, owing to the heat and moisture in the atmosphere. In this case it is necessary to add a small amount of alkali, preferably carbonate of ammonia, to counteract this tendency. As it is not possible to use sufficient alkali to entirely counteract this effect without giving rise to other evils, two additional precautions may be adopted, first the addition of alcohol to the sensitizing bath, which aids quick drying and thus prevents insolubility, and second, the use of less sensitizer in the bath. If one's negatives are unduly dense and strong in contrasts it will be seen that anything which will give the effect of more generally uniform exposure will be of advantage. By the use of more sensitizer in the bath the tissue has the tendency to become insoluble without exposure, this tendency being analogous to sunning down to decrease contrasts in ordinary printing. Therefore, with such negatives in general use we can well afford to increase the strength of our bath. On the contrary, if our negatives are thin and flat, and we desire the utmost contrasts in our prints, it is advisable to reverse this plan and use a very weak bath. If, therefore, we are to adopt a certain sensitizing formula we should be governed by the conditions under which we are to work. Mr. A. J. Jarman recommends the following sensitizing solution for summer use: Bichromate of potassium (C. P.), 3 ounces; distilled water, 100 ounces; glycerine, 30 drops; salicylic acid (dissolved in hot water), 15 grains; carbonate of ammonia, 60 grains. To Mr. Harry Quilter is due the following: Ammonium bichromate, 1½ ounces; sodium carbonate, ¼ ounce; water, 25 ounces. Of this take one ounce and mix with two ounces of methylated (Columbia) spirit. This dries in fifteen minutes. Another sensitizing bath is recommended by Mr. G. T. Harris as follows: Potassium bichromate, 2 ounces; stronger ammonia water (ammonia ·880), 1 dram; sodium citrate, 120 grains; water 60 ounces. Tissue sensitized in this bath is said to keep well even in damp weather. A formula which we used during a summer's work is as follows: Water, 80 ounces; bichromate of potash, ½ ounce; ammonium carbonate, 20 grains. The winter formula retains the carbonate of ammonia as it facilitates development at all seasons, and increases the bichromate of potash to one ounce to the quart of water. As will be seen, this is approximately a 1½ per cent solution for summer use, and a 3 per cent solution for winter use. Some writers advocate the use of a 6 or 7 per cent bath for general use, but under no conditions should the amount of bichromate of potash exceed 7 per cent. On the other hand, if difficulty be experienced in getting proper contrasts with the negatives in use, the bath may be as weak as one quarter of 1 per cent.

A formula for sensitizing tissue which has especial advantages for warm, moist weather, is as follows: Water, 32 ounces; potassium bichromate, 2 ounces; stronger ammonia water (ammonia ·880) 12 minims. Now add 1 ounce of sulphuric ether to ½ ounce of alcohol and add the mixture to the sensitizing solution. This gives a quick-drying tissue and one which will be found readily soluble in development.

Sensitizing

The sensitizing solution having been made up we have next to apply it to the tissue. We need a deep agate-ware, zinc, or porcelain tray such as is used in negative development, and preferably one or two sizes larger than the pieces of tissue to be sensitized. Into this the sensitizing solution is poured until we have a depth of one inch—not less. The temperature of the solution is important. It should be used at a temperature of between 50° and 65°; never lower than 50°, nor higher than 65°. If lower, reticulation of the film may be caused; i higher the gelatine film may melt and run. In winte there will be no difficulty in keeping the bath at th proper temperature. In summer the tray containing th sensitizing solution should be set within a larger tra containing cracked ice, or preferably a freezing mixtur of salt and ice. It is not well to put ice in the tray wit the sensitizer. The sensitizing of tissue is most conveniently done at night, so that the tissue will be dr and ready for use the following morning. To sensitize the tissue, cut to the proper size, is thrust into the solution and completely immersed. A soft brush or spong is now passed over its face and back to remove air-bubbles, and it is allowed to soak for three minutes.

Drying the Tissue

As quickly as the sensitized sheet are withdrawn from the bath, one at time, they are placed face down on clean and well-polished ferrotype plate or sheet of talce glass and squeezed into close contact with the plate In summer, this plate should be made quite cold wit ice before use. The sheets are then set aside to dry i darkness or non-actinic light. If the tissue dries in les than four hours it is apt to be too insensitive for satisfactory use. If it takes longer than seven hours to dry, the gelatine is apt to become insoluble and the transfer will be difficult to effect. In such a case the prints will almost invariably have the appearance of over-exposure. After drying, the tissue can be stored in black-paper envelopes or in a box with a tight-fitting lid. It should be protected from light and moisture. After being sensitized the tissue gains in sensitiveness, that is, becomes insoluble and if kept too long will become wholly insoluble. The tissue should be used in two, three or four days after sensitizing. In moist, hot weather it will not be usable after five or six days. To find out whether the tissue is too old for use place a piece of it without previous exposure in warm water, gradually raising the temperature. If it does not dissolve at 110° or 120° Fahr., it is not suitable for printing.

Spirit Sensitizer

The introduction of a spirit sensitizer by the Autotype Company has been welcomed by many workers. The sensitizer is applied to the surface of the tissue, which is laid on paper, by means of a Blanchard (or Buckle's) brush, which is a piece of swansdown or flannelette, attached by means of an India-rubber band to the end of a strip of glass. Some of the solution is poured into a small dish and the brush when charged with it is passed over the surface freely and in all directions. It is then hung up to dry in a darkened room. After drying, which takes place in from ten to fifteen minutes, according to temperature, the tissue is ready for printing. A second coating of the tissue renders it more sensitive and better suited for negatives with harsh contrasts. The use of this sensitizer does not diminish sensitiveness, nor does unevenness of the print result. Carbon printers in a small way should appreciate the facility of being able to sensitize on the day of printing; while another advantage of the method is that it enables one to quickly repeat prints which may not be satisfactory in the first case.

The introduction of this Spirit Sensitizer may be said to effectually remove the only tedious operation involved in carbon printing and simplifies the process immensely.

Exposure

In carbon printing the image is not visible, the progress of reduction being judged by an actinometer. A form of actinometer in common use is Johnson's; Sawyer's and Burton's are also well-known forms.

The Safe Edge

In printing with carbon tissue it is necessary to have a safe edge of the tissue protected from the printing light and left in a soluble condition. This is called the safe edge and without it the gelatine is apt to stick to the tissue backing on the edges more tenaciously than to the transfer paper. This safe edge can be a mask of thin yellow paper, a line of black varnish around the edge of the negative, or the rebate of the printing-frame. An imperfectly opaque mask may cause trouble, especially with improperly kept or over-printed tissue.

Dampness

Carbon tissue should not be printed in damp weather; but if this cannot be avoided use a rubber printing-pad in the frame to protect the tissue from dampness as far as possible and transfer it immediately after printing to a tin tube or storage box containing calcium chloride. If the tissue sticks to the negative in the printing-frame, the face of the negative should be lightly rubbed with French chalk and dusted off. This precaution should always be taken in moist, hot weather. In using a negative strong in contrasts, good results can frequently be obtained by exposing the tissue to strong light for a few seconds before putting it in the printing-frame.

The Transfer

In coming to the operation of transferring the picture-image, it is necessary to determine whether we will use the single- or double-transfer method. Development of the image from the face of the film will give us merely the lights and shadows of the picture without half-tone; but by transferring the exposed film to a new support we can get at the back or under side of it where the penetration of light is most feeble. In this way we can develop the image and get the full range of tones from the highest light to deepest shadow, the half-tones being held or retained by the hard crust of the face of the film, which received the strongest impacts of light during the exposure. If we wet the exposed carbon tissue and bring it face down into contact with a piece of paper or other prepared support, strip off the original backing of the tissue and develop the image from the back of the film thus exposed, the picture will be reversed with regard to left and right on its new support. For many subjects this reversal is of little or no importance; hence, the single-transfer method is largely used for pictorial work and in portraiture. But where things must be represented in their proper places, we must again transfer the image to another and final support, which puts the lefts and rights as they are naturally seen. In the double-transfer method, the exposed print is first transferred to a temporary support, developed, cleared in alum solution and washed. It is now transferred by being brought into contact with a piece of final support or double transfer paper, or any other desired support, squeegeed and set aside to dry. When dry the temporary support is easily stripped away and the picture remains on the final support.

Single Transfer

By the single-transfer method we can make prints on paper, opal, glass, etc. Specially prepared paper can be bought in rolls or cut sizes and in several varieties of thickness and color, such as thick or thin heavy hand-made, smooth or rough in finish and heavy cream-tinted drawing-paper. The paper should be cut to sizes a little larger than the carbon tissue, and not smaller, as in such cases one of the edges may fall within the safe edge of the tissue and allow the backing to carry off a part of the image. In making the transfer the printed tissue is placed face down in a tray of cold water, 50° to 65° Fahr. and at the same time a sheet of the transfer paper is placed in the same or an adjoining tray, care being taken to remove all air-bubbles from both. In from thirty to sixty seconds, the tissue will be found to flatten out and finally will begin to turn up at its edges, film inward. When it begins to curl in this way it is brought face to face with the limp piece of transfer paper or other support, drawn out upon a squeegee board or zinc plate, and the two papers, with the film between them, are squeegeed into absolute contact, being covered with a piece of rubber cloth. A scraper squeegee must be used for this. It is essential that all water be expelled between the two pieces of paper, and that the contact of the surfaces shall be absolute, without any air-bells, etc. The two closely adhering sheets are then placed between blotters and put aside under evenly distributed pressure. After all the prints awaiting development are transferred in this manner, and placed in a pile with blotters between, they are left for twenty minutes to an hour or more, according to the pressure upon them, after which they are ready for development. The purpose of placing them under pressure is to ensure even adherence of the tissue to the transfer paper. With thin, smooth transfer paper this may be effected in ten minutes, but with the heavy rough papers an hour may be better. In using the rough papers, moreover, it will be well to soak the transfer paper itself for a half hour or so in cold water before making the transfer, afterward placing the adhering sheets under very heavy pressure. One test of the sufficiency of the time the prints are under pressure is to note whether the back of the transfer paper is stained yellow by the bichromate of potash in the gelatine film. If the print is to be transferred to matt opal or glass, instead of paper, for its support, these should be free from flaws of any kind, clean and free from grease, and coated a few hours previous to use with a solution of albumen. This is prepared by beating the whites of three eggs to a froth and adding one ounce of water with five drops of liquid ammonia, giving a thin viscid solution. Plates coated with this should be free from dust and have an imperceptibly fine film, which, acting as a substratum, holds the bichromated film firmly during the after development of the exposed tissue.

Development

After the prints have been under pressure for a sufficient length of time, they are immersed separately in a large tray containing a supply of water at a temperature of from 90° to 100° Fahr. They should be rocked for a few minutes and all air-bubbles removed. It will be noticed that the gelatine around the margin has begun to dissolve and is oozing out of the edge of the transfer paper.

Vhen this has gone on for a few moments more, re-
iove one of the prints to another tray containing water
from 100° to 110° Fahr. This is the developing-tray
id the water should be kept as nearly as possible at the
mperature stated. This can be effected by placing the
ay, a tin or zinc one, over a gas or an oil stove with
ame adjusted to the proper height. After being in this
armer water for a moment the print is ready for strip-
ing. Take one corner of the tissue backing and, with
ie other hand holding the print under the surface of
ie water, gently strip off the backing. If it comes off
adily it is an evidence of correct or under-exposure,
ut if it seems disinclined to strip, this is an evidence of
ver-exposure or partial insolubility of the tissue, and it
iould be allowed to remain longer in the warmer water.
the printing was correct the backing will leave behind
on the new support a thick gelatinous mass in which
first no detail can be seen. By gently rocking the
ay this mass will dissolve away and gradually the
nage will appear. Now lift the tissue and carefully
lace it, face up, on a slab of glass inclined at an angle
the bath and gently lave the image with the warm
ater by means of a glass, cup or large spoon. The
etails will gradually brighten up and in a minute or so
ie image will be fully developed. As soon as the print
developed a little lighter than it is to be when dried,
it darkens upon drying, it should be placed in a tray
cold water to stop development.

Fixing

The fixing or clearing bath hardens the gelatine film and eliminates all traces of the bichromate of potash which might
main in the film or paper after development. The
um bath is a 5 per cent solution of powdered alum
water. This bath must be filtered before use and
ay be used repeatedly. The prints remain in it for
om ten minutes to an hour, the former when thin
iper is used, the latter when using the heavy, rough
ipers. If there is any yellow stain from the bichromate
potash in either the print or single-transfer paper or
the temporary support, the immersion in the alum
ith must be continued until the tint has disappeared.
he prints are then washed for half an hour in gently

running water, or in several changes, and hung up by clips until thoroughly dry.

Double Transfer

In the double-transfer method there is choice of a variety of temporary supports and the final support on which the finished print remains may be almost any surface desired, as paper, wood, ivory, glass, opal, celluloid, canvas, leather. To make a double-transfer print on paper, we will suppose the reader is using as temporary support the commercially supplied flexible support. This is paper coated with insoluble gelatine and shellac, it is sold in rolls and cut sheets and may be used repeatedly. Before using it must be waxed, i. e., a thin film of wax must be spread over its entire surface. After each time of using, also, this "flexible support" must be thoroughly dried and again waxed before use. The waxing preparation can be bought, or made as follows: dissolve yellow resin, 6 drams, and pure beeswax, 2 drams, in one pint of turpentine. This waxing solution should be used some time before the support is required, so that the turpentine has time to evaporate. To apply the wax coating, put a little of the solution on a piece of flannel or wad of absorbent cotton; lay the sheet of temporary support on a board or table and rub the wax lightly over the face of the support. When all the supports have been waxed, go back to the first sheet and, with a large tuft of absorbent cotton, polish each sheet in turn. Care must be taken not to rub the wax off entirely at any point; what is needed is a thin film of wax over the whole surface of the support. All temporary supports, flexible or rigid, as opal, celluloid, must be waxed in this way before they are used.

The Final Transfer

The exposed tissue is first transferred to the temporary support, developed, alumed and washed as already described The second transfer to the final support can be made while the prints are still wet from the first transfer, bu is preferably made after they have been permitted to dry. The double-transfer paper or final support can be bought in rolls or cut sizes. It does not keep well hence too large a quantity should not be bought at one time. It is a plain paper coated with gelatine or alum

To make the final transfer, first soak the final transfer paper in water at 90° to 100° Fahr. until the gelatine surface is soft, spongy, or slimy, the idea being to get a perfectly soft, yielding bed for the carbon image on the temporary support. Place in a tray of cold water for a moment, with the carbon image on its temporary support, and withdraw the two together to avoid air-bubbles. Squeegee lightly but firmly and clip up in a dry room. In five or six hours, if then thoroughly dry, insert the point of a knife between the temporary and final support and pull the two apart. If the former has been properly waxed and the final transfer paper was in good condition and properly soaked, the carbon image will be found to have adhered to the gelatine surface of the final support and will leave the less tenacious waxed surface of the temporary support, thus giving the second transfer and a non-reversed image. The surface of the image will now have a finish exactly corresponding to that of the temporary support employed. If the final support is so old that the gelatine surface has become partly insoluble and will not soften, soak it in water at a higher temperature until it is soft and spongy. If even with quite hot water it will not become soft, the paper is probably worthless and should be thrown away. When soaked in water at a higher temperature than is absolutely necessary to soften the gelatine coating, the latter is apt to be washed off generally or locally and all or a portion of the picture will be left on the temporary support. The same thing will happen if the temporary support has not been properly waxed. If there is any wax on the carbon image after stripping, it can be removed by rubbing gently with a tuft of absorbent cotton dipped in wood alcohol. The print is now finished and can be trimmed and mounted. From this introduction to the principles and practice of carbon printing we proceed to a digest of many of its latest modifications and applications.

Sensitizing Modifications

One of the best known carbon workers, Mr. Henry W. Bennett, F. R. P. S., published some time since in *Photography* the results of a number of experiments in modifying the sensitizing bath for carbon tissue. We abstract the essential portions of this valuable paper, one of the most important in relation to the subject that has recently been issued, inasmuch as the author claims to have succeeded in controlling the gradation, detail and other qualities of the finished print by these additions to the sensitizing bath. In this, the latest work devoted to carbon printing, Mr. Bennett's paper very properly finds a place:

Various Sensitizers

Sodium Carbonate. — The results obtained by adding sodium carbonate to the sensitizing bath have been very promising, and for some special cases equal to those given by any other substance. The quantity that could be added with success required gauging very carefully, as it was found that if sufficient to ensure solubility and easy working were used, other difficulties were introduced; and, as a much smaller quantity would give improved gradation, another addition was made in combination with sodium carbonate to secure good working qualities, which will be described in a later paragraph. The effect is to lengthen slightly the gradations at the light end of the scale. *Potassium Carbonate* is very similar in its effect to sodium carbonate; a smaller proportion is sufficient to produce the same degree of modification. *Neutral Potassium Citrate.*—This salt has been added to the sensitizing bath by Professor Namias for conferring keeping qualities; and in testing it for my purpose—securing improved gradation—it was found to have a very marked effect. Used alone, however, the general working qualities of the tissue were no better than when a plain neutral solution of bichromate was used, but these qualities were easily secured by a further addition to the solution. *Sodium Citrate* may be substituted for the potassium salt, the differences are inappreciable. *Citric Acid.*—Although from the conditions recognized as being essential for the successful working of carbon tissue, especially when bath sensitized, this salt appears to be one of the least desirable additions to the sensitizing solution; yet it has given the best results in every respect. A small proportion produces a decided difference in gradation; the results can therefore be easily controlled or modified.

The inherent defect in bath-sensitized carbon tissue is the loss of gradation at the light end of the scale, the general effect being that which would be produced by exposing tissue to light and so fogging it or degrading its purity; and this grey veil robs the lighter tones of all their value, gradation, and brilliancy, and it still remains even if the portions of the print protected by the safe-edge are quite clean. By no care or precaution in drying have I been able to overcome this defect, and those most experienced in working the carbon process have invariably stated that bath-sensitized tissue is distinctly inferior to that sensitized in course of manufacture. It has been this defect more than any other that I have endeavored to remove, and the results obtained are not only thoroughly satisfactory, but from the data given, they can be modified by each worker as he may desire. Taking the substances named, they may be placed in the order in which they have been described, sodium carbonate producing least effect, and citric acid being unquestionably the best, and also offering the greatest power of control. It is absolutely essential, however, to neutralize, or more than neutralize, the acidity of the solution; and the method of obtaining an alkaline bath is the determining factor in securing good working qualities.

Ammonia

I have only succeeded in sensitizing tissue that would be as satisfactory in its ordinary working qualities as freshly-made sensitive tissue, by making the sensitizing solution alkaline with ammonia, whatever substance had been added for modifying the gradation. Although various degrees of alkalinity have been tested experimentally, that which has been found to be the most satisfactory and the most simple to determine has been to add ammonia to the sensitizing solution, after all the other ingredients have been dissolved, until the orange-red color of the bichromate changes to a lemon-yellow; and the smallest possible quantity of ammonia that will effect this change should be used. This amount will vary with the different substances or quantity of such substances added. In my earlier experiments with the carbonates, sufficient of these was added to the solution to effect a similar change, as the value of this condition of the bath was recognized; but, in all cases, the results obtained were very inferior in many respects to those resulting from a smaller proportion of carbonate with sufficient ammonia added to complete the change. For obtaining good working qualities—solubility, freedom from brittleness in developing, etc.—the value of ammonia cannot be over-stated; and although its full effect is most noticeable when added to a strong solution of simple bichromate—the most satisfactory sensitizing bath—yet its efficacy does not appear to be impaired by any of the substances given in this article, but as they modify the tissue, the effect of ammonia has to be examined carefully by comparative tests.

Formulæ In all the following formulæ the quantity of ammonia, represented by *x* is determined by the method given in the paragraph on ammonia: *A*. Potassium bichromate, 1 ounce; citric acid, ¼ ounce; ammonia, *x*; water, 50 ounces. *B*. Potassium bichromate, 1 ounce; citric acid, ½ to 1 dram; ammonia, *x*; water, 50 ounces. *C*. Potassium bichromate, 1 ounce; potassium citrate, ½ ounce; ammonia, *x*; water, 50 ounces. *D*. Potassium bichromate, 1 ounce; sodium carbonate (crystallized), ½ ounce; ammonia, *x*; water, 50 ounces.

In all cases the solids were dissolved separately anc their solutions mixed.

The solutions will keep well in stoppered bottles As a small quantity can be used if the tissue is kept fla —four or five ounces for six pieces 6½ by 8½ inches—the used solutions should be thrown away, o a larger quantity may be taken and used several time if fresh stock solution is added each time. A solutior used too many times will give uncertain results.

Results and Conclusions For general work solution *A* shoulc be used, as it secures the finest possibl gradation in the lighter work, a ful scale of tones, good shadow detail, and contrast without harshness. From a negative suitable for carbor printing a rich tint can always be obtained, as the tissue should be very uniform in quality and condition at the time of using. The difference between the various formulæ is entirely in the gradation resulting in th ighter tones. Solutions *B* or *D* may be used for underxposed negatives in which the lighter tones are relaively too strong or harsh, or for any work when the radation at the light end of the scale is too strongly narked and requires softening down. Solution *C* gives result similar to *B* with the larger quantity of citric cid. Formulæ *A* and *B* are preferable to *C* and *D*. The proportion of water may be varied according to he degree of contrast required, a stronger bath giving ess contrast and vice versa. This strength will be ound best for general work. The method of sensitizng adopted has been to immerse the tissue face downvards in the solution for ninety seconds, then lay it ace down on a sheet of glass and squeegee gently to emove as much solution as possible, and if any surface noisture should remain on the back rapidly remove it vith blotting-paper; then lift it by two corners and ently pull it from the glass, and hang it to dry.

Drying

Tissue sensitized by these formulæ is practically independent of drying conditions, provided that it dries within a noderately uniform time, from four to six hours. *Gas n the drying room has little or no effect.* In general workng the tissue has been in the highest degree satisfactory, nd very pleasant to use after working ready-sensitized issue that had been kept in a box with calcium chloride. t is extremely soluble, dissolving very gently and easily t a temperature of 100 degrees; the backing paper is ery easily removed after a few seconds' immersion in he developing-tank, and there is not the slightest tendncy to blister, nor break, nor to produce any mechanial defects even when development is very prolonged. n almost all cases the tissue has been sensitized at night nd used the following day, and no special precautions ave been taken between drying and using, the tissue eing simply put in an ordinary cardboard plate-box. s an experiment, some was left freely exposed to the ir for eight to ten hours after drying, and no difference ould be detected. As most of this work has been done uring the present summer, the wet weather has been a evere test of the efficacy of the methods adopted, both regard to drying the tissue and its after-working.

Speed

Tissue sensitized by the solutions given is considerably slower than that sensitized in the plain potassium-bichromate bath, but the gain in quality more than compensates for the loss of rapidity.

Although commercial tissues differ so much in speed when purchased sensitive, yet when sensitized on these baths they are all practically identical, excepting the new matt-surfaced tissues, which require only three-fifths of the exposure of the ordinary kinds. Black tissue will be approximately the same speed as Ilford P. O. P. when sensitised in bath A, so that if a narrow strip of this paper is placed along one side of the negative, it may be printed until the light tones are just as dark as required in the carbon print, and an actinometer dispensed with. Brown tissue will require rather longer exposure than this, about one-fourth, and red-chalk about one-third longer than black, or until the silver strip is dark enough for toning. Formulæ B, C, and D yield a tissue slower than that produced by A, the proportionate exposures necessary being approximately $A = 4$, B and $C = 5$, $D = 6$.

Keeping Qualities

I have tested the keeping qualities of tissues sensitized on these baths, always sensitizing a piece in a plain solution of potassium bichromate, and keeping under identical conditions for comparison. The method of storing has been under the pressure of an ordinary printing-frame — a method that would be effective with ordinary P. O. P. for many weeks. Ten days has been the test time, and although the results with some sensitizers have been superior to that given by the simple bichromate solution, yet in no case have the prints been so good or so clean as freshly sensitized tissue. The "safe-edge" has always been degraded, and the prints poor in quality. The solutions containing ammonia have been the most satisfactory, though far from good.

Carbon on Celluloid

Among the many final supports available in carbon printing, whether single or double transfer, celluloid finds a prominent place, being largely used by professional workers because of its surface finish, which is peculiarly adapted for portraiture. The celluloid should be sufficiently stout to prevent buckling, with a fine matted surface on one side.

Assuming that the tissue has been exposed beneath a negative and is ready for development, the following substratum must be at hand, having been previously prepared. It is composed as follows: Gelatine (Heinrich's hard), 2 ounces; water, 12 ounces; sugar, 2 drams. Allow the gelatine to soak for an hour. Meantime prepare in a separate vessel a solution of chrome alum, 15 grains; water (hot), 1 ounce.

The gelatine, water and sugar should be put in an earthen vessel, or prepared in a small, oatmeal-kettle (popularly known as a double boiler), so that the water boils around the pot or inner vessel and causes the liquefying of the gelatine. As soon as the gelatine is well melted and very hot, the hot chrome-alum solution may be added drop by drop, stirring the gelatine solution vigorously at the same time. Keep up the stirring for a short time after the last of the chrome-alum solution has been added. Then filter a small quantity of this into a cup or small pot, and as soon as it has cooled down slightly it will be ready for use.

Single Transfer

Have at hand a mixture of acetic acid, 1 ounce, water, 6 ounces. Take the pieces of celluloid, cut to a size somewhat larger than the tissue to be transferred, and rub the matt surface well with a piece of canton flannel, dipped into the acetic-acid mixture, until the surface is quite clean. Rinse under the faucet, and lay in a tray of clean water for use. For single transfer, take a piece of the celluloid in the left hand by one of the top corners, and pour on some of the gelatine substratum while warm, having the exposed tissue soaked in clean water. Lay it upon the gelatinized celluloid, which must be in position on the squeegee board. Directly upon the top of the tissue place a piece of India-rubber cloth, smooth side uppermost. Then apply the squeegee gently at first, increasing the pressure until all the excess of substratum has been squeezed out. Lift the cloth carefully, wipe off all the remaining substratum with a wet sponge, and put the print aside until the remaining pieces of exposed tissue have been treated in a similar manner. In the course of a quarter of an hour development may be proceeded with.

This is best commenced by laying the prints in cold water to allow them to soak for about one minute. Then place them in warm water, and allow to soak until the tissue begins to loosen. Now lift the tissue by one corner, throw it aside in the waste-basket, and proceed with the development by throwing warm water over the surface of the print with the right hand, holding the print by one corner with the left hand. In the course of a short time the print will be seen to be fully developed. It must now be carefully rinsed in a stream of gently running water, and placed in a tray containing a solution of common alum (not chrome alum), three ounces of alum to one hundred of water. Allow the print to remain in this for five minutes only. Then, after soaking in another tray of clean water for five minutes, the print may be washed in a gentle stream of water and hung up to dry.

Double Transfer

To produce carbon prints upon celluloid by double transfer, the process must be modified. Clean the celluloid as previously described, rinse under a faucet, drain, and while still wet pour over the matted surface the same substratum, draining the remainder back into the containing vessel. A large piece of celluloid may be cleaned and coated in the same way, four 5 x 7 pieces being cut therefrom when dry. As soon as the pieces of celluoid are coated they must be laid aside to dry in a clean rack.

The carbon print is developed upon a flexible support as in paper transfer, and dried. This being done, take a piece of the celluloid with its dried coating of substratum, cut it to a size a little larger than the print, and place it to soak in the 3 per cent alum solution described above. Meantime place the flexible support containing the print into clean water to soak for about fifteen minutes. The celluloid may be removed from the alum bath, and washed under the faucet. It must now be coated once more with the hot substratum, laid upon the squeegee board, and the wet print on the lexible support laid upon it. Cover this with rubber loth as above mentioned, and apply the squeegee careully and lightly, gradually increasing the pressure.

After about eight or ten strokes of the squeegee renove the cloth, and wipe the back of the support careully until it is free from gelatinous solution. Then ery carefully lift the celluloid and support together, tarting this lifting by inserting the tip of the blade of knife at one of the corners. Now suspend the celluoid, with the attached flexible support, to dry. When lry the support will come away freely from the celluoid. All that is necessary now is to place the celluloid, vhich will now have the print firmly attached to it, into tray of warm water for half a minute, then pass it hrough a tray of clean water and suspend to dry. As oon as the drying is complete it will be seen that the rint is perfect in every particular.

The substratum will keep in good working condition or about one week by the addition of a few drops of 0 per cent carbolic-acid solution.

Preparing Special Papers

Despite the great variety of transfer papers or supports commercially available, many workers prefer to prepare special papers for their own use, thus ecuring effects in surface finish, texture and color not btainable with the papers generally offered in the narket. The following method is applicable to all classes f paper: Take of Nelson No. 1 gelatine 4 ounces, nd let it soak for two hours in 25 ounces of warm vater; then melt over a slow fire in a water-pan. Put he gelatine into a jar, and set it in a pan of water over he fire and thoroughly dissolve, stirring it all the time; vhen dissolved add very slowly 60 grains of chrome lum, previously dissolved in 4 ounces of water. Stir ll the time it is being added; this will solidify the gelaine. Collect, and restore it to fluidity with as much lacial acid as is necessary. Now take the sheet of aper to be coated ready for receiving the carbon tisue, and pin it at all four corners on a board, and into he center pour a good supply of the mixture; for an mperial sheet, say 2 ounces. Take a brush and roughly o all over the paper with it; then take a flat squeegee and press it all over the paper, now backwards, then crossways, so that all the paper receives a good coating, but leaving as little on the paper as possible, except in the case of rough papers, which require a more liberal treatment. All that is squeegeed off the paper may be gathered up and returned to the pot for further use. Two ounces will leave plenty to return to the pot, but it is better to be liberal with it at the start. Hang up the paper to dry, and it is then ready for use.

Single Transfer Paper

Any good white sized paper may be made into a single transfer paper by rendering it waterproof. Immersion in acid-proof varnish (which may be diluted with alcohol for this purpose) will do this perfectly; or, in a lesser degree, it may be done by immersion in a solution of shellac, made by boiling three parts of shellac and one part of borax in thirty parts of water. Or an alcoholic solution of bleached shellac may be used, the object being simply to close the pores of the paper and make it sufficiently waterproof.

Transferring Prints to Rigid Supports

The print should be allowed to dry after development and transferred to the final support with a solution of gelatine made up as follows: Gelatine (hard) 1½ ounces; water, 20 ounces; chrome alum (saturated solution), 2 ounces.

Soak the gelatine until it has absorbed all the moisture it will (which will take about half an hour) then dissolve with heat (it is advisable to use hot-water bath), and add the alum. It is advisable to filter this solution through fine muslin as there may be some insoluble particles. Run the solution into a flat dish, which is kept warm in a hot-water bath. Cut the print a little smaller than the final support, allow it to remain in the solution until it is quite flat, squeegee the two together, bringing them in contact *under the solution.* When dry the temporary support should strip off readily. All traces of the waxing solution can be removed with benzol.

Transferring to Canvas, Silk, Etc.

To prepare canvas for carbon prints the canvas should be stretched upon a flat board and scrubbed well with soda solution until the canvas shows through the sizing. The anvas is then dried and coated with the following solu- on: Gelatine (cooking), 4 ounces; glycerine, 2 unces; sugar, 2 ounces; water, 30 ounces; chrome um (saturated solution), 1 ounce.

Three to four coatings of this solution are necessary, ry between each coating and rub down any uneven- ess with fine sandpaper. The print is developed in e ordinary manner on temporary support and when ry is placed in the solution until flat; the canvas is en brushed over with the solution. Pour a quantity f the solution over the canvas and before it has time to ry, or rather set or run off, lay the print on and squee- ee to the final support. The support is removed in the sual way when thoroughly dry. For other fabrics such s silks, linen, or calico, follow the instructions above; it is found that the material works up rough when pplying the solution, use the sandpaper freely until a mooth surface is obtained.

rints on Me- allic Supports

Carbon prints upon metal surfaces are invariably produced by single transfer, so that the developing is made direct pon the metal. If the plate should be made of brass, ickel-plated copper, or a bronze of almost any descrip- ion, then it is advisable to use a preliminary coating of ollodion. This is necessary because the chromic acid, hich forms the base of the bichromate of potash (used o sensitize the tissue), attacks the zinc contained in rass, or the nickel coating on copper, or any nickel lloy, combining with the nickel or zinc and liberating opper in a free state, giving spots and patches of cop- er upon the surface. Collodion, being an inert body, cts as a neutral layer upon the surface of the alloy.

Preparing the Surface

If it is desired to produce a grained surface upon, say a plate of copper or aluminum, proceed in the following man- er: Clean the copper plate well by dipping it into, nd rubbing it with a small rag mop dipped into a solu- ion of lye. This solution is made by dissolving a small uantity of potash lye—about four ounces dissolved in ne quart of warm water; allow it to cool off before se. The copper plate must be planished and polished reviously. Having cleaned the plate with the potash lye, wash it well and dry. When dry, brush the back of the plate over with shellac varnish, or asphaltum varnish. Allow to dry in a warm place. The plate should be handled by the edges only, the fingers not being allowed to touch the surface. The surface of the plate must now be rubbed well with a stick of charcoal such as is used by photo-engravers. Dip the plate and charcoal into water; lay the plate upon a smooth board, inclined over a sink so that in rubbing the surface backward and forward the surface grinding drops into the sink. The graining is produced by immersing the well-cleaned copper plate into a mixture of nitric acid, 1 ounce; water, 20 ounces. If the graining is to be coarser, the water must be reduced to 15 ounces. In the course of a short time it will be seen that the surface of the copper has been attacked by the acid. Rock the tray a little, and in the course of a minute or two, remove the plate, rinse it in running water, then scour the surface with a fine brass-wire scratch brush. This can be done by hand, or if possible use the rotary scratch brush in a scratch-brush lathe of a silver-plater. The object of the scratch brushing is to rub down any slight bur formed by the etching of the acid. The plate may now be washed by dipping into hot water. It will dry by its own heat. If aluminum be employed, hydrochloric acid (muriatic acid) must be used instead of nitric, because nitric acid will not attack aluminum except at a high temperature. The proportion of hydrochloric acid may be the same, with the addition of half an ounce of common salt. This lessens the intense action of the acid. The scratch-brushing must be resorted to as before, rinsing the plate, dipping into hot water and drying.

Transferring

Assuming now that a carbon print has been produced upon the tissue in the usual way, all that is necessary will be to take the copper, silvered, or aluminum plate and dip it in the lye. Rub lightly with a soft cotton mop, rinse in clean water, and as quickly as possible soak the exposed tissue. Dip the tissue and metal plate into a syrup composed of white granulated sugar, 1 pound; water, 1 pint. This solution must be used cold.

Place the soaked tissue and plate together; cover with a piece of India-rubber cloth, glazed side uppermost, place upon a level surface. Now apply a squeegee, lightly at first, then gradually increase the pressure at every stroke, not rapidly but with a slow heavy pressure. If several plates are used, some bright, some grained, the treatment is the same. Allow the plates to stand for fifteen or twenty minutes before developing. At the end of that period, place them in cold water, allow to soak for a minute or two, then transfer them to a larger tray containing warm water. Rock the tray so as to get rid of the air-bubbles on the surface. Take the first tray, half fill it with water of a somewhat higher temperature, take one of the metal plates out of the warm water, immerse it, then carefully lift the tissue from one corner. All that will be necessary now will be to throw the warm water over the surface of the plate with the right hand while holding the plate in a sloping position with the left hand. In a very short time the print will be fully developed. Wash it by dipping into clean cold water, then immerse in an alum-bath compound of common alum, 2 ounces; water, 100 ounces. The plate must remain in this bath for not more than five minutes, because the film should not be hardened too much, Proceed in the same way with the other plates, and after the alum bath, wash them by laying them in clean water from tray to tray giving a five minutes' time to soak, so as to completely remove the alum. They may be placed in a clean rack to dry.

Prints on Ivory

Should the ivory have any scratches upon its surface (they will be visible after immersion in water) it should be polished with a piece of fine "velvet" cork and a paste made with cuttlefish powder and water; then wash in distilled water, and dry with a soft cloth. Make a solution of Nelson's No. 1 gelatine 1 ounce, water 20 ounces. Soak the gelatine in the cold water until soft, then dissolve by gentle heat. In another vessel dissolve 12 grains of chrome alum in an ounce of warm water, and pour it slowly, in a very thin stream, into the gelatinuous solution, stirring rapidly all the time. The ivory need not be "coated" in the usual sense; proceed as follows:—Put the picture on its temporary support in cold distilled water until it is quite flaccid, then immerse the ivory and the print in the warm chrome gelatine solution, and bring their surfaces together. Remove together carefully (avoiding air-bells), and then apply the squeegee very gently, with just enough force to expel the surplus gelatine. When quite dry, the temporary support may easily be removed.

Prints on Japanese Tissue

Assuming suitable negatives and subjects, carbon prints closely resembling photogravures in richness and depth of color can be obtained by the use of Japanese tissues as the final support. In this method the Japan tissue is placed on a glass support, the paper being cut somewhat larger than the glass, when it is coated with a plain collodion made up as follows: alcohol, sp. gr. 0.81, 100 parts; ether, sp. gr. 0.72, 100 parts; pyroxyline, 5 parts. Old celluloid films can be dissolved in amyl acetate, or equal parts of alcohol and ether, and used for the same purpose. With a camel's-hair brush, about one inch in width, commence at one edge of the paper on the glass support, and as rapidly as possible, using the collodion freely, coat the whole of the paper, at the same time pressing it into contact with the glass as intimately as the brush will permit. This first coating should thoroughly dry, when it will be found that the paper will be drawn perfectly flat to the glass support, if the coating has been properly done. Two or three additional coats should be applied until the pores of the paper are closed, but not enough collodion used to give the Japan tissue support too much gloss and destroy the texture of the paper. After the paper on the glass is dry, bend back the surplus paper over the edge on to the back of the glass support, and hold it there by placing it on another glass, keeping the two together during the development of the carbon print. This will prevent the water from getting between the print and the glass, and lessen the possibility of tearing the print. Sensitize the carbon tissue and print as usual. When ready to squeegee the printed tissue to the prepared Japan tissue support, immerse the print and the tissue support in the water at the same time and squeegee as usual. No previous soaking of the tissue support is necessary. In twenty minutes development can proceed as usual. The print during development should be examined with some white opaque substance behind it, or it will probably dry out too dark. The finely divided coloring matter can be thoroughly removed from the print, when sufficiently developed, by flooding with alcohol *once*, in the same manner in which a plate is flowed with developer. The print can now be rinsed and placed in alum or sodium bisulphite to eliminate the bichromate, washed again, and permitted to dry on the glass support. After drying, it should be carefully stripped from the glass and is ready for mounting. The tone of the picture can be modified by backing the print with colored paper. If old collodion is on the glass, the print will be almost sure to stick. Rubbing the glass with talc will facilitate the removal of the print. If the collodion is *flowed* on the paper, the result will not be satisfactory; the collodion *must* penetrate the paper instead of setting on the surface.

Auto-Pastel

Auto-Pastel is a pigmented paper, somewhat similar to carbon tissue. It is supplied in eight colors: Sepia, indian-ink, light red, dark red, green-black, blue-black, dark blue and dark green; the whole sheets are 15 x 24 inches, and the half sheets 12 x 15 inches; they may be obtained in assorted colors. The paper is supplied in an unsensitized state, but the operation of sensitizing is simple, the paper being immersed for one minute in 5 per cent solution of bichromate of potash, and dried in a dark, warm room; the drying takes about half an hour. It is not advisable to sensitize the paper and store it for long periods; it should not be kept for longer than about eight days after sensitizing. Printing is carried out as in the carbon process, and the negative should be fairly strong. Full exposure may be given, as there is plenty of latitude in development. The continuating action of light after removal from the printing-frame is the same as in the carbon process, and allowance should be made for this if development is to be deferred; the sooner the print is developed after removal from the printing-frame the better. After removal from the frame, the paper is first soaked for a few minutes in cold water, and the transferred to a dish containing hot water of a temperature from 125° to 150° Fahr. The object of first soakin in cold water is to ensure uniform action of the ho water. The paper is floated in the hot water, fac downwards, for two or three minutes, the dish bein kept moving. It is then turned face upwards, an development is begun by gently brushing the surface i all directions with a three- or four-inch camel's-hair brush beginning at the edge and working to the center. It i imperative that development be carried out *under wate* and that the brush should be used with a *sweeping*, an not a stippling action, gentle rubbing being all that necessary. In a few minutes the image will begin t appear, and the worker may then control developmen making it local or general, to suit his own taste. O completion of development the print is washed in col water and dried. During development it is not nece sary to keep the water at a constant temperatur although it should not be allowed to get too cold. Th surface should always be kept under water, as once th print dries, it cannot be altered by re-immersion.

Trichrome Carbon

In the Autotype Trichrome Carbo process negatives of colored objects a taken on color-sensitive plates, which a used with ray filters or screens as in orthochromat methods. The negatives are then printed on tissues suitable colors, viz., red, blue, and yellow. The resul ing images are developed and superimposed on o support. The tissues, yellow, red and blue, are sens tized, dried and printed in the ordinary way, the neg tives being provided with safe edges. The exposur however, differs somewhat from the ordinary carb printing. The negatives being very thin, the exposur are more rapid than with ordinary tissues. The follo ing has been found to be the approximate ratio exposure: blue, 2; red, 3; yellow, 8. After exposu the prints are squeegeed on semi-transparent, tempora supports and developed in water at 95° to 100° Fah After development they are rinsed in cold water a placed to dry. The best support for the final transfer the prints has been found to be the single transfer pap

The pieces of this it is intended to use should first be placed in cold water for half an hour and then, before use, into hot water, 140° Fahr., for fifteen minutes. When ready take a sheet of this paper and place in a dish of cold water and immerse the yellow print at the same time. Place the yellow print face to face with the transfer paper under water, lift both out together in close contact and hang up to dry. It is not necessary to squeegee. When the print has become dry, raise the support at one corner with a sharp knife, and then run a paper knife between the two to separate them. The yellow print having been successfully transferred, the red print is next taken up. Before attempting to transfer the red print, it is necessary to remove from the yellow print every trace of the waxing solution. This is done by rubbing the print over with a piece of rag wetted with benzole and a little whiting. Both the red and blue prints are transferred in the same manner. The yellow print, on its final support, is immersed in clean, cold water, and when flat is laid in the transferring solution face upwards. Soak the red print in cold water, and place that also in the solution face downward upon the yellow print, avoiding the air-bells. Lift both out together and lay them on a sheet of glass. The semi-transparent nature of the temporary support allows the prints to be easily examined by transmitting light, and the registration of the superimposed images is easily effected. The images resting on a glass are now stood on one side to drain, the two being then detached from the glass and hung up to dry. The transfer of the third, or blue print, is accomplished in exactly the same mander, including the treatment with benzole. No alum should be used until the final print has been transferred, then the threefold compound picture may be placed in a very weak solution of formaline. Accuracy of registration is facilitated by placing on the negatives at diagonal points two tiny black dots, which will appear white in the resulting prints. These white dots are pierced with a needle on the dry prints and brought together during the transfers. If they fit accurately it may be assumed that the registration is correct. The transfer solution is made as follows: Nelson's No. 1

cut gelatine, 1 ounce to 60 ounces of water. This is drained before use and employed at a temperature of not over 90° Fahr.

Printing by Magnesium

The following method of carbon printing by magnesium light, given by G. H. James in the *Amateur Photographer* a few years ago, will interest those who think themselves obliged to use gaslight papers and print at night because the daylight hours must be given to more serious business. It requires, in addition to sensitized carbon tissue, an actinometer of simple construction (which will serve equally well for daylight work), and a supply of magnesium ribbon which can be obtained from any photographic dealer at a cost of about 60 cents (2/6).

To make the actinometer, cut nine pieces of thin bond or post paper, each one inch wide and respectively 9, 8, 7, 6, 5, 4, 3, 2, and one inch in length. Beginning with the nine-inch piece and taking them in order according to their length, paste these one over the other so as to form a strip having nine graded thicknesses, each division having one less piece of paper than its neighboring division. Placing this graded screen in a printing frame and exposing a rapid plate behind it for five seconds at a distance of two feet from an ordinary gas flame, we get, on development, a negative with a series of graded densities, starting with absolutely clear glass at one end and ending with a square of considerable opacity at the other. Cut off the two squares of least density, and, beginning with the lowest density, number the squares in plain black or transparent figures from one to seven. Number one will correspond to the density of a thin negative, such as is used in contact bromide printing, while number four will correspond in density with a fairly strong negative, such as is used in platinum printing, and so on. The actinometer is now ready for use, the point for comparison between the actinometer tint and the negative in use being the densest part of the negative.

The following table, based on practical experience, gives the different lengths of magnesium ribbon required in the exposure of negatives corresponding to the various tints of the actinometer described ;

ctinometer tint	Magnesium ribbon	Distance between negative and light	Length of time burning (about)
1	2½ feet	4 inches	1½ minutes
2	4½ feet	4 inches	2½ minutes
3	6½ feet	4 inches	3½ minutes
4	8½ feet	4 inches	4½ minutes
5	10½ feet	4 inches	5½ minutes
6	12½ feet	4 inches	6½ minutes
7	About 15 or 16 feet		

It will be noticed that the amount of ribbon used ncreases regularly for each tint up to No. 6. After the irst tint has been reached by burning two and one-half eet of ribbon, it then merely requires an additional two eet for each further tint desired. This does away with ll but the smallest amount of experiment and will often nable the worker to dispense with the use of any actin- meter. All that is necessary is to ascertain by experi- nent the exposure required by a standard negative, referably a thin one, and then, by comparison of any ther negative with this standard, to estimate the mount of ribbon required.

The printing is done by burning the required length f ribbon, suspended over a metal tray, at the given listance from the printing-frame containing the negative nd carbon tissue. It will often be found convenient to xpose three or four pieces of tissue at a time by rranging as many printing-frames in a triangle or quare, standing them on their edges and allowing the ibbon to hang down in the center. With frames larger han 6½ x 8½ in size, this method will drive the burn- ng ribbon a greater distance from the negatives than he table allows for, viz: four inches, and due allow- nce must be made for this in printing from large egatives. Mr. James states that this method has proved ompletely successful in his experience.

Defects and Failures

The following exhaustive summary of defects and remedies in carbon printing was prepared by Mr. H. W. Bennett, nd may well conclude our account of the process.

torage of Tissue ; When sensitive tissue cannot be used as soon as received, it must be protected from the action of the atmosphere as well as light. Wrapping in waterproof paper and storing in a printing-frame under pressure will fulfil all requirements for two or three days. If not so preserved the tissue rapidly becomes insoluble. For longer keeping a receptacle containing dry chloride of calcium may be used. This preserves the solubility of the tissue for a long time, but makes the tissue brittle, so that it requires handling with care, as it is difficult to avoid cracking the film. If this method of storage is adopted, the tissue should be exposed to the air in a dark cupboard or drawer for an hour at least before printing. **Preparing Tissue for Printing:** To prevent the attraction of dust and other small particles, the tissue should be dusted with a soft fabric before placing in contact with the negative. **Safe Edge:** The tissue should be placed so that it does not project beyond the projecting safe edge. It must be covered on all sides to the extent of one eighth of an inch, at the least, by the safe edge or frilling in development will occur. **Printing:** The same brand of silver paper must be used for the actinometer by which the depth of printing is gauged or uniform results cannot be obtained.

The Image Is Too Light: This is principally caused by under-printing. If the exposure has been carefully gauged and the correct exposure for that negative is known, the weakness of the image may be caused by want of sensitiveness in the tissue. The result may arise from the over-development of a correctly exposed print or from commencing development with water at too high a temperature. One hundred and five degrees may be considered the standard temperature. **The Image Is Too Dark:** This is mainly due to over-printing but may be the result of variations in the sensitiveness of the tissue. **Age of Tissue:** The tissue may have been kept too long and become partially insoluble in consequence. Or the prints may have been kept too long after exposure without means being taken to arrest the continuing action of light, which goes on after the print is taken from the frame. This continuing action may be largely checked by keeping the print under moderate pressure, or entirely stopped by storing the print in a calcium tube or box. **Non-adhesion of Tissue**: The printed tissue may fail to adhere to the single-transfer paper. The transfer paper may not have been soaked long enough. A thin paper will not require more than four or five minutes. A thick and rough paper should remain in water twenty or thirty minutes. The print may have been soaked in water too long before squeegeeing into contact. Dry tissue will curl with the sensitive side inwards on being placed in cold water. As it becomes impregnated with water it straightens out and finally curls with the sensitive face outward. It should be taken from the water and squeegeed into contact before it becomes quite flat. If the soaking is allowed to proceed too far, this curling tendency will be sufficiently strong to cause it to leave the transfer paper. The want of adhesion due to these two causes s evident at the time of squeegeeing the prints to the ransfer paper.

Insolubility of the Tissue: When the tissue has become insoluble through long keeping after sensitizing, it requently peels away from the transfer paper, partially or entirely, when an attempt is made to remove the backing-paper. **Insufficient Water**: Between the tissue and transfer paper when squeegeeing into contact may esult in imperfect adhesion. **Air-Bubbles**: These, on he tissue when soaked in water previously to squeegeeng it to the transfer paper will produce patches of imperect contact and consequently fail to adhere. If allowed o remain on the transfer paper in the preliminary soakng, they will lead to a similar result. **Blisters**: These, during development, are the result of imperfect adhesion nd are frequently due to the causes just given. **Frilling**: Another example of the defect, which is frequently aused by the edges of the print not being protected by safe edge. Very hot water or prolonged development may either cause or aggravate the defects of blisters and rilling. **Non-adhesion of Printed Tissue to Temporary Support**: This may be due to the following causes in ddition to those relating to single-transfer paper. Inufficient waxing solution applied to the temporary upport, or polishing and rubbing off too much of the olution. The surface of the temporary support should be rubbed carefully with a piece of soft, fluffless fabric, after applying the solution. This should be sufficient to render the coating uniform. The support should be left with a slight surface moisture. Using the temporary support too soon after waxing is a certain cause of failures. One hour at the very least should elapse if the support is hung in a dry and warm room. With careful storage, the supports may be kept indefinitely after waxing.

Backing Paper Difficult to Remove: This may arise from insolubility of the tissue, to excessive over-printing, or to removing the backing-paper too soon after placing the print in the hot water. When this difficulty is experienced, the print should be allowed to remain a few seconds longer and another attempt made from a different corner. **Streaks and Markings:** These may appear on the surface of the print as soon as the image is visible. They are mostly caused by not keeping the print completely submerged during the removal of the backing-paper, or making long pauses during that operation. **Circular or Irregular Patches:** These, if lighter, than the surrounding work and having a dark margin, occur in the lighter tones of the picture in the early stages of development, and are due to leaving the print too long before stripping off the backing-paper. They frequently disappear during the progress of development. The backing-paper should be removed as soon as possible after placing in the hot water. **Light Streaks, Markings or Patches:** These may arise during development or in the alum bath. They are frequently caused by allowing the surface of the print to come into contact with other prints, the fingers, or any solid substance. The film is very delicate, and nothing must be allowed to touch it until after drying. When rewetted for double transfer or for mounting, it may be touched without injury. **Defects in Drying on Temporary Support:** At this stage the film may leave the temporary support. This is caused by drying too rapidly or in a place tha is too warm. A cool place and slow drying are desirable. **Film does not Adhere to Final Support in Double Transfer:** The final support or the temporary suppor bearing the print may not have been soaked sufficiently in cold water. At least fifteen minutes should be allowed so that the gelatine may absorb water fully. The final support may not have been immersed in warm water. It may have been immersed too long or the water may have been too hot. Immersion in warm water is necessary after the long soaking in cold in order to soften the gelatine coating sufficiently to enable it to adapt itself to the relief of the image, and also to cause it to adhere. The water must be about 90° Fahr. The final support should be immersed for a few seconds only, just until the gelatine becomes soft and yielding. If left soaking too long or in water that is too warm, part of the gelatine coating dissolves away and insufficient remains to form a bedding for the image. The gelatine should be in a semi-soluble condition when the transfer is made.

Double Transfer: In working double transfer on drawing-paper the failure to adhere may arise from the paper intended for the final support having received too thin a coating of gelatine. From 26 to 30 ounces of a one-in-thirty solution of gelatine should be used for six imperial sheets of drawing paper. This should be applied in three or four coatings. The image will also fail to adhere to the final support if too little gelatine is used in making the transfer. **Film Failing to Leave Temporary Support:** This is due to insufficiently waxing the temporary support. **Non-sensitized Carbon Tissue:** The unsensitized tissue will deteriorate if allowed to become damp. It will keep indefinitely in a dry and cool place. **Sensitizing and Drying:** To secure uniform sensitiveness the strength and temperature of the sensitizing bath and the time of immersion should be as uniform as possible. The sensitizing bath should always be alkaline: an acid solution produces partial insolubility of the tissue. In drying tissue after sensitizing, if it is allowed to remain on a ferrotype plate, a little of the sensitizing solution must be left between the tissue and the plate before squeegeeing. If the tissue is drained before squeegeeing and there is no liquid between its face and that of the plate, it will fail to strip after drying. Drying at too high a temperature after sensitizing will spoil the working qualities of the tissue. Spots or patches of uneven sensitiveness are caused by air-bubbles forming either on the back or the face of the tissue. They should be removed immediately after immersion.

Ozobrome The modification of carbon printing known as ozobrome deserves mention here. As the reader knows, an ordinary carbon print consists of pigment in gelatine, obtained by printing through the negative on to sensitized tissue and subsequent development. Ozobrome gives a similar result by less direct but simpler means. The sensitized pigmented tissue is squeegeed face down on a bromide or velox print upon which it deposits the carbon pigment. Then, the silver of the bromide print being removed, an image in pure carbon pigment remains on the paper. An alternative process is to strip the carbon tissue from the bromide print and transfer it to some other suitable surface. By this process any number of carbon prints can be made from the bromide print: the image on the latter being redeveloped each time. The number of carbon prints that can be obtained in this way depends upon the power of the bromide print or enlargement to resist the action of the various baths. Now, as bromide enlarging is quite a simple process, it is obvious that the production of large carbon prints from small negatives becomes easy.

It will thus be seen that carbon printing by the ozobrome process places the worker in possession of many valuable advantages. He can print without light as no exposure of the tissue is necessary. Then, bromide or developing paper, the first sensitive surface to be used, is everywhere available in several grades, so that no sensitizing operation is required. Moreover, enlarged negatives for carbon enlargements are not needed, as, in place of them bromide enlargements on paper are used. The image not being reversed double transfer is not necessary. To end up this brief list of the principal advantages of ozobrome: printing from a negative is quite dispensed with, and, as any kind of negative can be used for making the bromide print or the enlargement, the different grades of bromide and developing-out papers make it easy to produce soft or contrasty ozobrome prints at will.

The working instructions for ozobrome printing were given in No. 81 of THE PHOTO-MINIATURE (September, 1907). We need not, therefore, repeat them. Since the date mentioned the materials required for the process have been placed on the market by the Eastman Kodak Company. Given the production of the bromide print or enlargement, no special apparatus beyond a thermometer and hot water are required. The tissue is supplied in the following colors: engraving-black, warm black, blue-black, sepia, warm sepia, portrait-brown, vandyke-brown, red chalk, terra-cotta, marine-blue, sea-green, Italian green. A sensitizing powder is requisite; this also is supplied; and finally, seven kinds of transfer paper: (*a*) fine white, smooth; (*b*) medium grain matt; (*c*) white etching; (*d*) toned etching; (*e*) stout drawing medium. The tissues and the transfer papers are issued in cut sheets and rolls.

Carbograph

Modified carbon printing also finds expression in a new process called carbograph, which was introduced by the Rotary Photographic Company, of London, in November, 1907. Here the end aimed at is the direct production of carbon enlargements or contact prints by exposure to artificial light and subsequent development. The carbograph process is briefly as follows: The paper bears a coating of carbon pigment and silver bromide in gelatine. After exposure to artificial light either in contact with a negative, or in the enlarging lantern, a ferrous oxalate or iron citrate solution is used to develop an image of metallic silver in the paper. The print is next cleared in acetic acid, washed, and then sensitized in a solution of potassium bichromate and alum. This solution hardens or renders insoluble the gelatine film in direct proportion to the amount of silver reduced in it. The sensitized silver-pigment print is then transferred to a suitable support, and the soluble gelatine developed away, as in ordinary carbon work. It is now necessary to fix out the unaltered silver bromide which remains in the film: this is done in a solution of hypo. After washing, the prints will still contain metallic silver. To remove this, a reducing solution of hypo and potassium ferrocyanide is recommended. Then an impression in pure carbon will be left. Failing the removal of the silver, the image is a compound of metallic silver and carbon pigment. Alternatively, the original developed image may be reduced out of the film before the latter is sensitized in a modified bichromate-alum bath. The print is next fixed, washed, dried, transferred to its support and developed as in ordinary carbon work. Carbograph may still be regarded as in its probationary stages, as regards the public use of it; but it may be pointed out that it is by no means novel, as we can clearly trace its origin to a suggestion of the late Leon Warneke which was published in the year 1881. Moreover, we take leave to question the permanency of a process which in its result is a compound of deposited silver and pigment unless the intermediate operations have been very carefully conducted.

Leto Pigment Paper

This new pigment paper deserves mention here as combining the simplicity of the carbon method with the adaptiveness for pictorial effects peculiar to the gum-bichromate process. It is imported by J. L. Lewis, New York, and consists of paper coated with very thin pigmented gelatine. Sensitizing is done with a brush, a spirit sensitizer being employed, and the paper dries in ten to fifteen minutes. Leto pigment is about twice as sensitive as print-out paper and printing in the shade is advised, the use of an actinometer being necessary. Development and clearing are effected as in carbon printing, the use of brushes of different sorts and sizes permitting of a wide range of modification in development.

BOOKS

Carbon Printing. By E. J. Wall. 104 pp., with a carbon print. 5th edition. 1900. (Eng.) 50 cents.

Carbon Printing. By W. Weston. 64 pp. 1896. 75 cents. This relates to the working of Elliott's tissues.

Carbon Printing. By Max Bölte. 32 pp. 2nd edition. 1893. 50 cents. A full and practical manual.

Carbon Photography Made Easy. By Thos. Illingworth. 154 pp. 1903.

Notes and Comment

⁂ The title page, contents and index for Volume VII of "THE PHOTO-MINIATURE," Nos. 73 to 84, inclusive, are now ready and may be had on application, accompanied by two cents in stamps.

◆

The dream of today is the reality of tomorrow. A European university has instituted a Professorship of Photography. Lecturing in the Acland Museum of Oxford University in the year 1901, one of the present editors of THE PHOTO-MINIATURE pleaded for the elevation of photography to the dignity of a Professorate. Every day sees some new step made toward the rescue of a practical photography from mere rule-of-thumb and empirical methods; and it is good to know that educational authorities are recognizing that it may be taught in terms of scientific exactitude.

◆

The Kodak Company, of London, has recently held at Bombay an exhibition of photographs which was described by the local press as probably the finest collection of the kind yet seen in India. The company is manifesting great activity in India at the present time, the business there being organized by Hedley M. Smith, formerly manager of the Paris branch of the company. The Indian amateur should especially welcome the opportunity of working with the Kodak Tank Developer.

◆

The Progress Medal of the Royal Photographic Society has, we learn, been awarded to J. Sterry, for his photo-chemical investigations and for researches and writings on sensitometry and on the action of substances on the latent image. Sterry was one of the first to appreciate and popularize the work of Hurter and Driffield. Besides his experimental work, he has done much writing and is the author of a popular book, "Photography by Rule."

◆

The Annual Convention of the Professional Photographers' Society of New York will be held on March 31, April 1 and 2 next, in the building of the Metropolitan Life Insurance Company. The President of the year is A. F. Bradley. A fifty-dollar gold prize; studio demonstrations; lectures and demonstrations of the Autochrome process, and the annual dinner will be features of the proceedings.

◆

Amateur and professional photographers should welcome the convenience of being able to procure a set of spotting colors for negatives, transparencies and prints. The Devoe Set issued by the Devoe and Raynolds Co., Fulton and William streets, New York will be found to serve the purpose admirably. There are five spotting colors in a japanned tin box 2 by 8 inches with two brushes, and the price is 50 cents, mailed free.

◆

Two additions to the resources of the film photographer have recently been made: The "Barnet" roll films being obtainable from J. L. Lewis, 379 Sixth avenue, New York: and the Ensign films from G. Gennert, 24-26 East 13th street, New York.

◆

Our readers will be interested in knowing that plates and materials for the Autochrome process are now obtainable from the American house of the Lumière Company, at 11 West 27th street, New York. A recent issue of *The Century Magazine* contained some three-color reproductions of Lumière Autochromes, the first, we believe, to be published in this country. A writer in "The Amateur Photographer" allows himself to characterize the frontispiece as a "picture of a green globe and a shock-headed man who is apparently in the act of concealing a copy of *Camera Work*," and adds that this "must make the brilliant and imperious photographic Mahdi whom it represents (Alfred Stieglitz) doubt the impeccability of Mr. Steicher's impressions." But why "Mahdi?"

❧

The Wager Exposure Scale and the Wager definition scale are now manufactured by Burke and James, 118-132, West Jackson Boulevard, Chicago. As our readers know, the first of these is a neat and popular form of exposure meter; the second a tabular guide to the exposures required on moving objects.

❧

In our next issue we hope to find room for an interesting paragraph on a lot of desirable mounting papers recently introduced by the Mittineague Paper Company, of Mittineague, Mass. This well-known firm has an enviable reputation in the world of high-class cover, writing and book papers, and its entry into the photographic field is an event which promises much for those who appreciate the value and importance of the mount as a setting for the photograph.

❧

Penrose's Pictorial Annual, 1907-8: The Process Year Book. Edited by William Gamble. 185 pp.; illustrated; $2.50. Tennant & Ward, New York, American agents. To the process worker Mr. William Gamble's beautiful book has become an annual necessity. In the issue before us there are 270 illustrations, many of them in color and over sixty articles by authorities on process matters. "Color photography" supplies the subject of many of those articles, the Warner-Powrie process coming in for reference. Amongst the illustrations is a three-color reproduction of an Autochrome. Collotypes; photolithos; two- and three-color prints; many line and halftone pictures are amongst the superb gallery of illustrations which "Penrose" serves up in this annual feast for the eye. We heartily commend this beautiful and useful book.

❧

In *Photograms of the Year 1907*, the work of the Editor, Mr. H. Snowden Ward, manifests itself more prominently than hitherto. A. C. R. Carter, the successor to Gleeson White, the book's first critic-in-chief, having retired from the position, Mr. Ward himself properly steps into the vacancy without diminishing the authority or value of the volume one jot. Indeed, we look upon the change as distinctly to be approbated, for photography has too long had to suffer under the patronage of back-pattings of superior critics from the picture-galleries and the dry-as-dust reviews. As a record of progress in pictorial photography and a well-judged series of critiques, the book before us is of the highest value. We do not say that it should form part of every photographer's library; but it deserves to, which is better. It is obtainable of Tennant & Ward, New York. Paper covers, $1; cloth, $1.50.

❧

Errata in THE PHOTO-MINIATURE No. 84. The reader is advised to correct the types in The Photo-Miniature to read as follows: page 569, seventeenth line from foot of page—sodium *carbonate* 240 grains; page 571, twenty minutes development formula, add to Solution C—water 16 ounces; page 579, second column from right at foot read 15 instead of 14; page 583, second column from right at foot read 11 instead of 21.

Books and Prints

All books noticed in these pages may be obtained from the publishers of THE PHOTO-MINIATURE, and will be promptly forwarded, postpaid, to any address on receipt of the publishers' prices as here quoted.

The 1908 U. S. edition of the Burroughs Wellcome *Diary and Exposure Record* is now ready, price, 50 cents. *Real Colour Photography*, by R. Child Bayley, a practical résumé of Autochrome color work, is also on sale, price, 50 cents.

❧

Flashlight Photography Made Easy, an illustrated book which forms a succinct guide to the subject, has been published and is to be had free on application to the Luxo Company, 1226 Arch street, Philadelphia.

❧

Fallowfield's Photographic Annual, 1907–8. This volume of nearly 1,100 pages is the largest and most complete catalogue of photographic supplies that has come under our notice. It is published by Fallowfield, one of the oldest firms of dealers in the world, at 146 Charing Cross Road, London, W. C.

❧

Titles for Photographs. Published from the offices of "Focus," London. Price 25 cents. A well-known English writer, Mr. A Lys Baldry, sent out, some time ago, a volume full of titles for photographers and printers, and it met, we believe, with quite a favorable reception at the hands of those whom it was designed to help. The compiler of this far less pretentious little book has catered simply for amateur photographers, who in their work seek to break away from the more commonplace titles that inevitably occur to new recruits in picture-making. Poets and other writers have been drawn upon for inspiration, and the resultant book is a collection of telling lines applicable to a great variety of subjects.

◆

Color Photography. By George E. Brown, F. I. C., and C. Welborne Piper, 16 pp. Price, 15 cents, Tennant and Ward, New York. This brochure is a short résumé of practical experiences with the Autochrome process.

◆

The focal plane shutter and the action photographs for which it is mainly used is the theme of a beautifully produced and instructive little book that has been sent us by the Folmer & Schwing Co., Rochester, N. Y. There are over 30 examples of high-speed work in the book, which sells at 25 cents, and much valuable data regarding the practical applications of the focal plane shutter. With this book for a guide, the photographer should not fail in very rapid exposures on moving objects. It cleverly condenses the whole teaching of the subject; and should be carefully studied by the would-be recorder of the rapid motion of animate and inanimate objects.

◆

The Kodak Baby-Book, issued by the Eastman Kodak Company, Rochester, N. Y., is a prettily illustrated book on child portraiture at home. The picture and letterpress are the work of Mr. C. H. Claudy Copies are obtainable of any Kodak dealer.

◆

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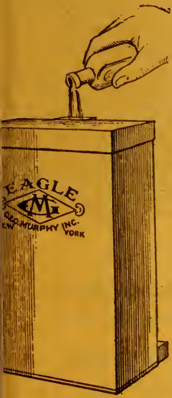

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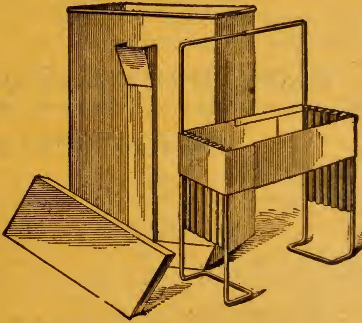

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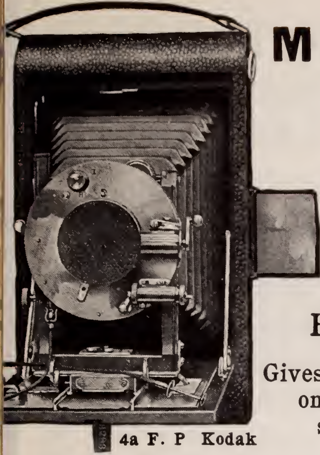

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ispipe will record on plate twice as thick; with $\frac{1}{800}$ sec. $1\frac{1}{2}$ as thick;
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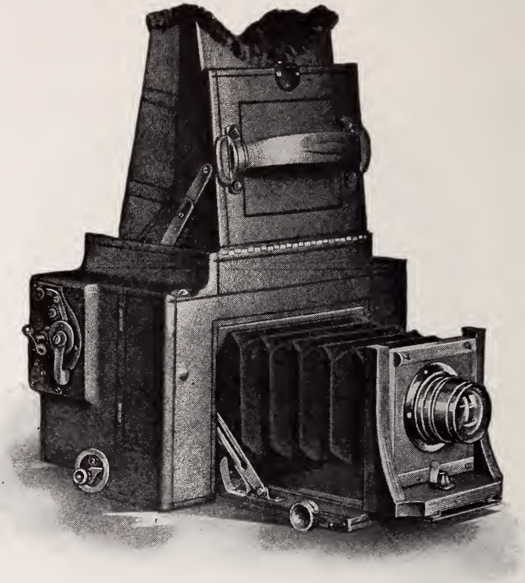

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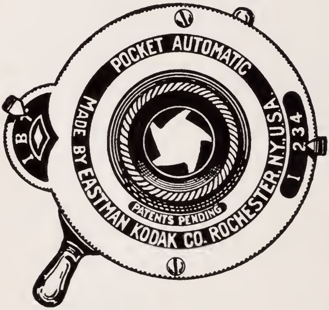

As may be seen by the illustra above, this shutter, instead of op ing outward in a series of increa circles to the full limit of the phragm opening, instantly gives star-shaped opening, permitting light to fully cover the exposed are film during the entire time of expos

There can be no reasonable c tradiction to the argument tha shutter working on the iris diaphr system falls considerably short giving the *full time for the full open* For instance, if the full opening is one-fourth of an inch, and the t exposure is one twenty-fifth of a second, it is obvious that a very c siderable part of the illumination is lost by the time taken up by leaves of the diaphragm in opening and closing.

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Of course everybody who has investigated photography understands ıat, theoretically, there is no such thing as a fixed focus lens. But in ractical use, short focus lenses may be used without a focusing device, rovided the stop opening is not too large. The camera then is a fixed ɔcus instrument, though the lens cannot be properly so-called.

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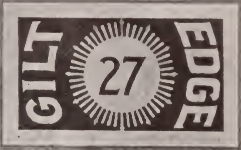

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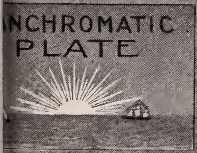

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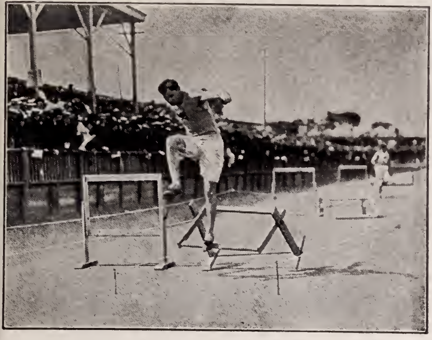

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